REMARKS

Applicants respectfully request reconsideration and allowance of the pending claims.

I. Status of the Claims

Upon entry of this amendment, claims 1-9 and 72-78 remain pending.

II. Claim Rejections Under 35 U.S.C. §103(a)

Reconsideration is requested of the rejection of claims 1-9 and 72-78 as being obvious over Itoh et al. (U.S. 5,024,905). As explained in more detail below, the claims are patentable because

a) the reference lacks the technical teaching required for *prima facie* obviousness;

b) one skilled in the art would have had no reasonable expectation of success of preparing catalyst alloys having an average particles size less than 25 angstroms by applying Itoh et al.'s techniques; and

c) the cited reference is a non-enabling disclosure vis-à-vis the claimed subject matter.

Claim 1 is directed to a composition for use as a catalyst in oxidation or reduction reactions, the composition comprising platinum and copper, wherein (i) the concentration of platinum is greater than 50 atomic percent and less than about 80 atomic percent, and (ii) the composition has an ***average*** particle size which is less than 25 angstroms (Å).

Paragraph [0051] further clarifies the particle size limitation of the composition defined by claim 1 as pertaining to the average particle size:

> [0051] It is to be noted that, as additionally detailed elsewhere herein, one or more of the methods (e.g., freeze-drying, alloying, washing) and/or conditions thereof (e.g., alloying temperature and/or duration, pH of the acidic solution and/or the atmosphere employed when dissolving, for example, copper from the catalyst composition) employed to prepare the catalyst compositions of the present invention may be controlled in order to control or limit the particle size of the resulting catalyst composition. Preferably, one or more of these methods and/or method conditions are controlled such that the catalyst composition has an ***average particle size***, on for example the electrically conductive support, which is no greater than about 5 nm (50 Å), more preferably no greater than about 4 nm (40 Å), still more preferably no greater than about 3.5 nm (35 Å), still more preferably no greater than about 3 nm (30 Å), ***still more preferably no greater than about 2.5 nm (25 Å)***, still more preferably no greater than about 2 nm (20 Å), still more preferably no greater than about 1.5 nm (15 Å), and still more preferably no greater than about 1 nm (10 Å); the ***average size of the catalyst composition*** may therefore be in the range of, for example, greater than about 10 Å to less than 50 Å, greater than about 15 Å to less than 40 Å, greater than about 20 Å to less than 35 Å, greater than about 20 Å to less than 30 Å, or greater than about 25 Å to less than 30 Å.

The "average" particle size limitation has its normal mathematical meaning, i.e., the arithmetic mean, which is defined as "a value that is computed by dividing the sum of a set of terms by the number of terms." See Merriam-Webster, ©2009. The average is therefore a single value that is computed from a range of values that can and often do vary from the average value. By requiring the particle size be expressed as its average, the claim encompasses a composition in which a

population of particles has an average size of less than 25 angstroms, but the size of any particular particle may deviate (and many particles certainly deviate from the average) from the average, so long as the average particle size of the entire population of particles is less than 25 angstroms, the claim covers the composition. Compositions comprising particles that range in size from less than 25 angstroms to greater than 25 angstroms but having an average particle size of greater than 25 angstroms are distinguishable from the claim. Such compositions do not fall within the scope of the claim and do not infringe the claim. Nor do such compositions, if earlier, anticipate or render obvious the claim.

The alloys exemplified in applicants' specification at Tables P, Q, and R2 having an average particle size of less than 25 angstroms were prepared according to a multi-step process, the description of which begins with Example 3, paragraph [0167]. In a first step, applicants prepared a suspension comprising a selected concentration of copper nitrate and platinum supported on carbon support. The suspension was freeze dried for 24 hours to remove the solvent. See paragraph [0168]. Next, the dried solids were subjected to "a heat treatment to reduce the constituents therein to their metallic state, and to fully or partially alloy the copper and the platinum on the carbon black particles." See paragraph [0169]. This process yielded the PtCu alloys having the characteristics described in Tables P and Q. As shown in Tables P and Q, the alloying temperatures ranged from 600°C to 900°C, and the heating durations ranged from as little as 2 hours to as much as 12 hours, and numerous examples show that the average particle sizes were less than 25 angstroms even after 7, or even 12 hours of heating. See, for example, Powder number 287 in Table P,

which was heated for 7 hours and had a particle size of approximately 23 angstroms. See also powder number 365 in Table p, which was heated for 7 hours and had a particle size of 22 angstroms. Applicants have provided numerous examples of Pt-Cu alloys having compositions meeting the claimed platinum content and meeting the claimed average particle size requirement.

While these PtCu alloys are catalyst materials having redox activity, the process for forming catalytic compositions meeting the requirements of claim 1 is not necessarily complete. In some embodiments, the catalytic materials are subjected to various washing steps as described in Example 5, the conditions of which are outlined in Table R1. Washing involves acid washing in order to remove a portion of the copper loading, to thereby yield PtCu alloys having relatively high platinum concentrations that also meet the average particle size requirements of claim 1. See, for example powder number 645 which was heated for 12 hours (per Table R1) and had an average particle size of 22 angstroms (per Table R2). Applicants' process for preparing the platinum-copper catalyst materials of claim 1 having an average particle size of less than 25 angstroms therefore involves mixing the materials together, freeze drying the mixture, reducing the copper, and finally a subtractive process step in which some of the materials are washed/leached away.

Itoh et al. disclose quaternary ordered alloys of platinum-iron-cobalt-copper comprising 40 to 70 atomic % platinum, 9 to 27 atomic % iron, 9 to 27 atomic % cobalt, and 9 to 27 atomic % copper. See the abstract and Col. 3, lines 52-59 of Itoh et al. As described in Col. 4, lines 57-68, the minimum concentrations of 9 atomic % ensure that the iron, cobalt, and copper additions affect the catalyst properties such that if the concentrations

are less than 9 atomic %, the catalyst "shows activity equivalent to that of a catalyst comprising platinum alone."

Itoh et al. describe two crystal lattice configurations: cubic ordered and tetragonal ordered. See Col. 3, lines 43-56. As described at Col. 6, lines 42-54, a heat treatment is necessary to form the metal components into an alloy and to order the alloy. At heat treatment temperatures between 600°C and 900°C, the alloy is cubic ordered, and at temperatures between 850°C and 1050°C, preferably between 900°C and 1000°C, the alloy is tetragonal ordered. The duration of heat treatment is between 30 minutes and 2 hours. Itoh et al. state that "Heat treatment at an excessively high temperature for a long period of time should be avoided because it grows the crystallite size of the alloy and decreases the surface area of the resulting catalyst." See Col. 6, lines 54-57. The following table summarizes the heating temperature and duration to form alloys having the crystallite sizes shown in Tables 1 and 2. The heating temperatures and durations were determined from Example 1 (Production Example 2) in which the heating temperature was 900°C for a duration of 1.2 hours. This heating profile was used for most examples. Some Examples used the heating profile of Example 3 (Production Example 5) in which the same heating duration was used, but the temperature was increased to 1000°C.

Table 1. Heating Temperature and Duration

Production Example No.	Catalyst	Heating Temperature (°C)	Duration (hours)	Crystallite Size (angstroms)
2	Pt-Fe-Co-Cu	900	1.2	33
4	Pt-Fe-Co-Cu	900	1.2	42
"	Pt-Fe-Co-Cu	900	1.2	35
"	Pt-Fe-Co-Cu	900	1.2	37

5	Pt-Fe-Co-Cu	1000	1.2	55
6	Pt-Fe-Co-Cu	1000	1.2	56
"	Pt-Fe-Co-Cu	1000	1.2	58
10	Pt-Fe-Co-Cu	900	1.2	48
"	Pt-Fe-Co-Cu	900	1.2	46
"	Pt-Fe-Co-Cu	900	1.2	43
3	Pt-Fe-Co-Cu	500	2	31
7	Pt-Fe-Co-Cu	900	1.2	47
"	Pt-Fe-Co-Cu	900	1.2	44
"	Pt-Fe-Co-Cu	900	1.2	54
8	Pt-Fe-Co-Cu	1000	1.2	62
"	Pt-Fe-Co-Cu	1000	1.2	59
"	Pt-Fe-Co-Cu	1000	1.2	54

Table 2. Heating Temperature and Duration

Production Example No.	Catalyst	Heating Temperature (°C)	Duration (hours)	Crystallite Size (angstroms)
1	Pt	Not Heated	0	23
9	Pt-Fe	900	1.2	34
"	Pt-Fe	900	1.2	39
11	Pt-Fe	1000	1.2	61
12	Pt-Co	900	1.2	33
"	Pt-Co	900	1.2	32
13	Pt-Cu	900	1.2	35
"	Pt-Cu	900	1.2	37
14	Pt-Fe-Co	900	1.2	35
15	Pt-Fe-Cu	900	1.2	38
16	Pt-Fe-Cu	900	1.2	40
17	Pt-Fe-Cu	900	1.2	34
18	Pt-Cr-Co	900	1.2	36
19	Pt-Co-Ni	900	1.2	32
20	Pt-Cr-Ni	900	1.2	33

The cited Itoh et al. reference does not disclose any Pt-Cu alloys having ***average*** particle size of less than 25 angstroms. The only production examples that were Pt-Cu alloys were those of Example 13, but these had average particle sizes of 35 and 37 angstroms. None of Itoh et al.'s other alloys had average particle sizes of less than 25 angstroms, as is apparent from

the above Tables, which were obtained directly from Itoh et al.'s disclosure. The only catalyst that had an average particle size of less than 25 angstroms was Production Example 1, but this material is pure platinum and certainly not a composition comprising copper, as required by the claims.

As endorsed by the MPEP at §2142, the legal concept of *prima facie* obviousness is an allocation of the burden of proof. The Office bears an initial burden of establishing *prima facie* obviousness, while applicants provide evidence only if such a showing is made. Herein, the Office's evidence supporting obviousness is the assertion that "both the size and the atomic % disclosed by Itoh overlap the size and atomic% ranges recited in the instant claims."

The cited portion of Itoh et al. for the particle size is Col. 9, lines 54-55, which states "Observation under an analytical transmission electron microscope, consisting of a high-resolution transmission electron microscope combined with an Angstrom X-ray microanalyzer, showed that the composition of the alloy particles having a size of 25 to 50 Å was Pt:Fe:Co:Cu atomic ratio=50:17:17:17 and the product was a solid solution alloy of Pt_2(FeCoCu)." This portion of Itoh et al. is excerpted from their Example 1 (Production Example 2), the description of which begins on Col. 8, line 65 and ends at Col. 9, line 55. The "crystallite size" of Production Example 2 is shown in Table 1 to be 33 angstroms. It is clear from the description that Itoh et al. describe a population of crystals that were analyzed under a transmission electron microscope having particle sizes ***ranging*** from 25 angstroms to 50 angstroms. That is, Itoh et al.'s description at Col. 9, lines 54-55 merely describes the smallest and the largest particle sizes observed, and the various particles observed under TEM had sizes between 25 and 50

angstroms. These boundaries do not equate to an average. A composition in which the particle sizes ***range*** from 25 angstroms to 50 angstroms necessarily has an ***average*** particle size greater than the claim limitation of 25 angstroms since the minimum particle size is 25 angstroms and a portion of the particles have a size greater than 25 angstroms, which increases the average to over 25 angstroms. There is no need to speculate as to the ***average*** particle size, however, since Itoh et al. disclose it in Table 1: the ***average*** crystallite size was 33 angstroms, which is more than 25% greater than the claim limitation. Therefore, contrary to the Office's assertion that "the size...disclosed by Itoh et al....overlap the size...of the instant claims" in fact, the ***average*** particle size of Itoh et al.'s Production Example 2 of 33 angstroms is substantially greater than the ***average*** particle size limitation of the claim. There is in fact no overlap at all with respect to this example or any other material described in Itoh et al., so MPEP §2144.05 does not suffice to establish *prima facie* obviousness herein in view of the Itoh et al. reference. Since Itoh et al. does not render the composition defined by claim 1 obvious, the rejection should be withdrawn.

In view of the critical shortcoming of Itoh et al., which does not disclose any alloy or composite having average particle size less than 25 angstroms, *prima facie* obviousness cannot be established. Itoh et al.'s disclosure is additionally deficient since their disclosure would not have provided the ordinarily skilled person with any reasonable expectation that their teachings could be successfully applied toward producing Pt-Cu alloy particles having the claimed platinum concentration and the average particle size requirement. See MPEP §2143.02:

2143.02 Reasonable Expectation of Success Is Required

> A rationale to support a conclusion that a claim would have been obvious is that all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions, and the combination would have yielded nothing more than predictable results to one of ordinary skill in the art. *KSR International Co. v. Teleflex Inc.*, 550 U.S. ___, ___, 82 USPQ2d 1385, 1395 (2007); *Sakraida v. AG Pro, Inc.*, 425 U.S. 273, 282, 189 USPQ 449, 453 (1976); *Anderson's-Black Rock, Inc. v. Pavement Salvage Co.*, 396 U.S. 57, 62-63, 163 USPQ 673, 675 (1969); *Great Atlantic & P. Tea Co. v. Supermarket Equipment Corp.*, 340 U.S. 147, 152, 87 USPQ 303, 306 (1950).

Section II of MPEP 2143.02 goes on to describe that applicants' rebuttal evidence showing there is no reasonable expectation of success supports a finding of non-obviousness, and further to describe specific situations where this has occurred. A first piece of evidence that the ordinarily skilled person would not have had any reasonable expectation of successfully preparing catalyst alloys having an average particles size less than 25 angstroms by applying Itoh et al.'s techniques is Itoh et al.'s total failure in preparing any such material, as described above. Itoh et al. prepared 31 alloys and not one of those alloys exhibited average crystallite size of less than 30 angstroms, much less the claimed requirement of an average of less than 25 angstroms.

Second, applicants have described the method by which they achieved Pt-Cu alloys having an average particle size of less than 25 angstroms. As described in their specification, applicants process for preparing platinum-copper catalyst materials of having the claimed average sizes involves mixing the materials together, freeze drying the mixture, reducing the copper, and finally a subtractive process step in which some of

the materials are washed/leached away. Applicants have further provided numerous examples showing that that heat treatment may ***extend up to 12 hours*** and still achieved the claimed average particle size. Applicants, therefore, have discovered and disclosed a truly distinctive process compared to Itoh et al. for preparing the claimed alloy composition.

Itoh et al. fail to disclose any such process, nor do they provide the ordinarily skilled person with any basis for concluding that any modifications of their process would reasonably be expected to prepare alloys having the claimed average particle size limit. Itoh et al. explain that heating is a necessary step in their process for reducing the ions into component metals and for ordering the component materials into crystals. Itoh et al. state that heating may range from 30 minutes to 2 hours, but should not be excessively long so as to avoid forming large crystals. As shown in the above Tables, Itoh et al. heated their materials for a very short duration compared to applicants -- as little as 72 minutes -- and still prepared alloy materials having average crystallite sizes exceeding the claimed maximum. Again, a minimum heating time ***is necessary*** to achieve the reduction and ordering reactions, and yet, there is no evidence in Itoh et al. whatsoever that shortening the heating duration is adequate to reduce the metal ions, order the alloys, and achieve smaller average particle sizes. Simply stated, the ordinarily skilled person would perceive no basis for modifying Itoh et al.'s method to prepare alloy materials within the claimed ***average*** particle size.

Finally, it is not enough that a prior art reference recites the limitations of a pending claim; the disclosure must be an enabling one. Itoh et al. failed to enable the preparation of a Pt-Cu having an average particle size of less

than 25 angstroms. The Federal Circuit has stated that "even if the claimed invention is disclosed in a printed publication, that disclosure will not suffice as prior art if it was not enabling." *In re Donohue*, 766 F.2d 531, 533 (Fed. Cir. 1985), citing *In re Borst*, 345 F.2d 851, 855, 145 USPQ 554, 557 (CCPA 1965). Additionally, as endorsed by MPEP §2121 and the Federal Circuit's recent opinion in *Impax Laboratories, Inc. v. Aventis Pharmaceuticals Inc.*, 88 USPQ2d 1381 (Fed. Cir. 2008), the standard is whether the prior art reference enables the ordinarily skilled person to make the claimed invention without undue experimentation. See 88 USPQ2d at 1383:

> In order to anticipate a claimed invention, a prior art reference must enable one of ordinary skill in the art to make the invention without undue experimentation. Finisar Corp. v. DirecTV Group, Inc., 523 F.3d 1323, 1336 [86 USPQ2d 1609] (Fed. Cir. 2008) (citing In re Omeprazole Patent Litig., 483 F.3d 1364, 1379 [82 USPQ2d 1643] (Fed. Cir. 2007)). In other words, ***the prior art must enable the claimed invention.*** Minn. Mining & Mfg. Co. v. Chemque, Inc. (3M), 303 F.3d 1294, 1301 [64 USPQ2d 1270] (Fed. Cir. 2002).

In this regard, applicants are not contesting the ability of the ordinarily skilled person to employ Itoh et al.'s technique for preparing catalyst materials having average particle sizes of 31 angstroms or more, as evidenced by multiple production examples shown in Tables 1 and 2. However, applicants' claims specifically and expressly require average particle size of less than 25 angstroms. The standard as set forth in *Donahue*, *Borst*, and *Impax Laboratories* requires the Office to show that the reference enables preparation of Pt-Cu catalyst materials having an average particle size of less than 25 angstroms or else *prima facie* obviousness cannot be established. Recognition that

smaller particle sizes is desirable is not enough to render the claims obvious when, as here, Itoh et al. utterly fail to disclose any process capable of preparing any material meeting the claimed average particle size limitation, or even suggest process modifications that may result in particles meeting the limitation. Itoh et al.'s 31 production examples -- none of which even approach the claimed average particle size limitation -- are substantial evidence of non-enablement of preparing particles having average particle sizes of less than 25 angstroms. In view thereof, applicants respectfully submit that the reference does not render the claims obvious for the additional reason that the reference does not enable the claimed subject matter.

In view of the foregoing, the Itoh et al. reference neither anticipates nor renders obvious the compositions of claim 1, and applicants request the rejection be withdrawn.

Claims 2-9 and 72-78 depend from claim 1 and are patentable for the same reasons as claim 1 and by virtue of the additional requirements therein.

For example, claims 5, 6, 74, and 75 require the compositions have average particle sizes of less than 20 angstroms, or less than 15 angstroms. These claims are additionally patentable over Itoh et al. since they did not disclose any composition having average particle sizes less than 20 angstroms. In fact, the composition which had the smallest particle size was the pure platinum catalyst, having an average particle size of 23 angstroms.

III. Double Patenting Rejections

Applicants acknowledge the provisional double patenting rejection of claims 1-8 and 72-77 over co-pending application

Ser. No. 11/205,557 and the provisional double patenting rejection of claims 1-9 and 72-78 over co-pending application Ser. No. 11/341,119. Unless and until the co-pending applications mature into patents or the double patenting rejection is the sole remaining rejection in the present case, the appropriateness of the rejection cannot be ascertained. Applicants therefore request that the double patenting rejection be held in abeyance until one of these conditions is met.

CONCLUSION

In view of the foregoing, applicants respectfully request reconsideration and allowance of the pending claims. Applicants do not believe that a fee is required for the filing of this response, as it is being submitted within the 3 month shortened statutory period for reply. Should applicants be incorrect, the Commissioner is hereby authorized to charge the necessary fee to Deposit Account No. 19-1345.

Respectfully submitted,

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